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Research and Development

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Project Summary

Volatilized Lubricant Emissions from Steel Rolling Operations

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This report presents the results of an investigation of the volatilization of lubricants used in steel rolling operations. Data from nine steel rolling operations were used to define the volatilized portion of lubricants used in rolling operations; and to prepare total oil, grease and hydraulic fluid material balances for actual and "typical" cold and hot rolling operations. Estimates of the air pollution resulting from both hot and cold rolling processes were made from data acquired by questionnaires, mill visits, and emission source sampling. Background information pertaining to steel rolling operations, lubrication practices, rolling mill lubricants, and rolling emulsion application technique is also presented.

This Project Summary was developed by EPA's Industrial Environmental Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

In a previous study, entitled "The Use and Fate of Lubricants, Oils, Greases, and Hydraulic Fluids in the Iron and Steel Industry," (EPA-600/2-78-101, May 1978), it was determined that a typical integrated steel facility may emit, as air pollution, 10 percent of the total quantity of oil, grease, and hydraulic fluid used. That study further demonstrated that 80 to 90 percent of the total oil, grease, and hydraulic fluid utilized by an integrated mill were consumed by the steel rolling and finishing operations.

Lubricants, oils, greases, and hydraulic fluids are potentially significant sources of pollution in the iron and steel industry because large quantities are used and there are numerous applications of these materials. Pacific Environmental Services, Inc., was contracted to investigate volatilized lubricant and hydraulic fluid emissions from the steel industry. As in the previously cited study, fuel oils, solvents, tars, pitch, transformer oils, wash oils, and quench oils were excluded from the investigation. That previous investigation revealed that the two major potential sources of volatilized oils, greases, and hydraulic fluids were the rolling/finishing mills and sinter plants. Sinter plants have been and are being considered by other EPA-supported studies and therefore were not addressed in this study.

The purpose of this study was to investigate volatilization of oils, greases, and hydraulic fluids during usage in the steel industry. A determination was made of the quantity and characteristics of the resultant hydrocarbon emissions. The main sources of volatilized oil hydrocarbon emissions were identified and described by equipment type and plant area. Lubricating and operating

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practices affecting oil volatilization and hydrocarbon emissions were also investigated. The four major goals were: (1) to survey the steel industry and collect data to perform oil, lubricant, and hydraulic fluid mass balances around individual mill operations; (2) to sample representative mills to verify the volatilization quantities calculated from the initial mass balance; (3) to identify the quantity of lubricant volatilized by specific mill processes and determine the resulting hydrocarbon species and (4) to develop a standard methodology to perform mass balances for typical mill processes from the data compiled from the previous three objectives.

The project consisted of the following data gathering tasks. The first was a comprehensive literature search utilizing the resources of several technical libraries, trade journals, texts, handbooks, technical papers, and NTIS microfiche. Background information was collected on processes and equipment, lubrication practices, and waste oil collection and reclamation. Organizations, societies and industries supported by, knowledgeable of, or composed of iron and steel personnel were contacted to obtain information useful for the study. The second task was conducted to obtain detailed and current data on steel mill lubricants in the rolling/finishing mill areas. In the third task, a questionnaire was developed which was directed at specific mill operations. Data were received from five plants, and four plant visits were arranged. The purpose of these visits was to obtain additional data, to inspect equipment identified as significant hydrocarbon emissions sources of volatilized lubricants, and to discuss the proposed sampling program.

Task 5 was conducted at two steel mill facilities: the Inland Steel Indiana Harbor Works and the Gary Works of United States Steel. Stack samples from two cold roll mills were obtained from the Inland Steel facility. Ambient (building) air samples were acquired from the 84-inch hot strip mill located at the U.S. Steel's Gary Works. Rolling oil samples and wastewater samples were also gathered from each of the locations. A gas chromatographic analysis was performed on each of the air samples. Each wastewater sample was also analyzed to determine the amount of oil present in the water during the air sampling period.

Laboratory experiments of Task 6 were performed under controlled conditions on a typical rolling oil to determine the quantity of lubricant volatilized and the resulting hydrocarbon species. The results of this laboratory simulation were compared to the in-plant sampling results and the material balance estimates of the volatilized oil loss.

The data gathered in Tasks 1 through 6 were reviewed and used to estimate hydrocarbon emissions resulting from volatilized lubricants and hydraulic fluids. These estimates were applied to the specific steel plants included in the study, a "typical" steel plant, and the domestic steel industry as a whole. The types of hydrocarbons produced by those evaluated processes were identified and quantified wherever possible.

Summary of Results

The findings of this study were in general agreement with those of a previous study which estimates a typical integrated steel plant, with a raw steel production capacity of 3.6 million metric tons per year (4 million tons/year), 6,530 metric tons per year (7,200 tons/year) of oils, greases, and hydraulic fluids are used throughout the plant. Since between 80 and 90 percent of these lubricants are used in the steel rolling and finishing operations, this study concentrated on those operations. It was estimated that for a typical cold strip mill, total hydrocarbon emissions were 358 metric tons per year (395 tons/year). Therefore, the total hydrocarbon emissions rate for all cold strip mills within the U.S. is estimated to be 7,160 metric tons per year (7,900 tons/year). The confidence levels of estimates of hydrocarbon emissions from hot rolling operations are not as high as those from cold rolling, primarily because insufficient data were collected to enable more direct and precise calculation of these emissions. (Two of the three methods used for hot rolling estimates agreed relatively closely; the third included two estimated variables: one with a factor of 2 range and the other with an order of magnitude range. Incorporating the two variables produced estimates with a factor of 20 range.) Using these estimates, total hydrocarbon emissions from a typical hot strip mill were 94.7 metric tons per year (104 tons/year) or 2,460 metric tons per year (2,700 tons/year) for all hot strip mills within the U.S. It was also estimated that of the total quantity of oil, grease, and hydraulic fluid used by the various rolling operations, approximately 12.5 percent of the lubricants purchased will enter the environment as air pollution.

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J. S. Ruppersberger is the EPA Project Officer (see below).
The complete report, entitled "Volatilized Lubricant Emissions from Steel Rolling Operations," (Order No. PB 81-108 003; Cost: $17.00, subject to change) will be available only from:
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Springfield, VA 22161
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